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In Depth Analysis of the Home to Work Travel Pattern in the Istanbul Metropolitan Area

Abstract

This paper investigates home to work travel pattern in the Istanbul Metropolitan Area. Investigation explores commuting pattern in three steps. In the first step, the reasons for changing commuting time are explored initially in relationship to urban structure. Added explanation then considers the gender, tenure type, income, occupation and commuting type. The result related with gender is consistent with the previous studies however income is not. Occupation and commuting type appear to be strongly affected on differences on commuting time. In the second step, the home to work travel pattern is explored whether it reflects consistency with the standard urban economic theory. Results reflect that the behavioral assumption of cost minimization for the journey to work in the standard model is inadequate when explaining the relation between job and housing location. In the third step, the home to work travel pattern is investigated in local context in terms of spatial distribution of workers both on working and residential areas. While living and working at the same geographic part of the metropolitan area or the district decreases the commuting time, living and working at the different geographic part of the metropolitan area or the district significantly increases the commuting time.

Keywords: home to work travel, commuting pattern, commuting time, Istanbul

1. Introduction

The Bosphourus creek divides the Istanbul Metoropolitan Area (IMA) into two main geographical parts, namely European and Asian. Not only the population distribution but also the spatial distribution of economic activities and employment are remarkably different in these two geographic parts. For instance, 89% of manufacturing sector firms is located on the European side and only 11% on the Asian side. Also, 77% of manufacturing sector employment is clustered in the European side and 23% of it in Asian side (IMP, 2005a). Alike, almost 70 % of service sector firms are located on the European side and 30% on the Asian side. Also, 72% of service sector employment is located in the European side and only 28% of it in Asian side (IMP, 2005b). These figures show how economic activities are clustered mainly in one geographic part that emerges not only a dense flow from the Asian part to the European part but also a dense inflow within the European part.

In a general term, almost 70% of employment is clustered in the European side and 30% of it in Asian side. 16% of the workers who are residing in the Asian side travel from the Asian side to the European side in every day to be able to reach their job areas. However, the workers who are living in European part and working at the Asian part are only 2%. When the districts in the Asian part are investigated, it is seen that workers who are both living in and working at the Asian part is changed between 67% and 93%. However, at least 7% and at most 33% of workers cross the Bosphourus in every day. The volume of flow from the Asian part to the European part is striking which emerges a dense traffic problem. The real commuting time is over the expected commuting time in the metropolitan area.

In such a spatial distribution, the aim of the study is defined as to understand home to work journey pattern in the Istanbul Metropolitan Area (IMA). Consistent analyses are developed to reach the aim in the extent of (1) varying subjects expecting to have an impact on home to work pattern, (2) the standard model of the urban economics (3) local context in terms of spatial distribution of workers both on working and residential areas. A bundle of research questions that developed due to the aim is classified corresponding to the three extents that emphasized above.

How long does it take to workers to get their workplace? Does commuting time differ in two main geographical parts of the metropolitan area? Is commuting time is sensitive to variations in the urban structure? Does travel time to work differ for men and women? Is commuting time sensitive to tenure type? How do workers usually get the work? How does

commuting time change in case of more than one worker at a home? Does the commuting time directly increase in an increase in the individuals' income level? How does home to work pattern change according to occupational class? To answer these questions, some statistical tests are applied and according to test results the home to work journey pattern is reflected in relation with geography, spatial structure, gender, socio-economic factors, and homeownership which are expected to have an impact on home to work pattern.

Is the choice among residential locations determined by a trade-off between commuting cost and land cost? Is the behavior of cost-minimizing in the standard model adequate to explain the commuting in the IMA? How much is the access to the workplace important in residential location choice? Is the choice among residential locations determined by primary wage earners or secondary wage earners? How is trade-off between commuting cost and land cost affected in case of two wage earners in a family? Is journey to work cost getting less important as long as the income increase? By this second bundle of questions, it is analyzed whether the commuting cost and land cost relation reflect consistency with standard model in the IMA.

Does the commuting time significantly differ for workers whose living and working areas are at the same geographic part and are at the different geographic part? Do the commuting time of workers who is living in Asian/European part and working at the European/Asian part significantly differ from workers who is living in Asian/European part and also working at Asian/European part? Do the commuting time significantly differ for workers whose living and working areas are at the same district and workers whose working and living areas are at the different districts? By getting answers to these questions, it is aimed to reflect the volume of travel in flows according to macro (two geographical parts of the metropolitan area) and micro (districts) scales, also, the tendency of workers whether they would like to prefer to live within the same boundaries of working and living areas.

The paper is organized as follows. Section two reviews the relevant literature; the third section defines the methodology and describes the data. In the fourth part, the analysis and findings are presented. The final section offers some concluding remarks.

2. Background and Previous Studies

Home to work travel researches have an important role to analyze and reflect home to work travel pattern in an urban area. Several studies have been developed by focusing on the topic which provides both the theoretical and the methodological background. Some of these

studies have discussed commuting pattern by place of residence and by place of work. It has been discussed as one of the push or pulls factors on residential location choice in some studies. The discussion is supported by the standard model of urban economics that emphasizes the choice of residential location bases on the trade-off between commuting cost and land cost. The relation between travel cost to work and housing prices is the other topic that has been attractive for researchers. As a last, some researchers have developed indexes to compare actual and hypothetical travel patterns or to measure the jobs-housing balance.

The complicated structure of home to work travel pattern is reflected by several issues. Although most of these issues conflict, they strictly connect to each other at the same time. The spatial location of home and work area is the main determinant of the geographic pattern of commuter travel. Average commuting time, the volume of commuter travel at different time periods during a typical day, the volume of travel in flows between origin and destination are basically the result of these two spatial points. Additionally, in which parts of the city public transportation use are concentrated, where drive alone is the highest, which parts have the longest average travel time or reversely have the shortest average travel time are the other issues that depend on the spatial location of home and work area. Moreover, it is emphasized that gender, income level, occupation are the other issues that needed to be considered while analyzing the geographical pattern of commute travel (Singell & Lillydahl, 1986; Mensah, 1994).

The other important issue that has been discussed is the relationship between the land use pattern of an urban area and the commuting pattern (Peng, 1997; Rouwendal, 1998; Badoe & Miller, 2000). The relationship between the length of work trip and the land use pattern is well known. The general acceptance is that imbalances in land use occur when the number of workers who can be housed in an area differs substantially from the number of jobs there. Relatedly, the other issue is mismatches which occur when prices or other characteristics make housing in the area inadequate or expensive for the workers who holds job there (Giuliano & Small, 1993). In that context, the following question is how would a job-housing balance be concreted by redirecting new employment and housing at an urban area? To answer this question is very difficult. Household type, more than one worker in the household, the gender distribution of workers, the sociodemographic and economic structure of workers, housing tenure, interconnections and interdependencies between labor and housing markets and home-work interaction changes are some issues that increase the difficulty to give an answer to the question (Halvorson, 1973; Singell & Lillydahl, 1986;

Hanson & Pratt, 1988; Levinson, 1997). Because each of these issues emphasized above is inherently dynamic, they concrete a dynamic relationship between land use and work trip, on the other side, based on their inherent characteristics, this relationship might be in conflicting. Consequently, home-work links need to be continuously reexamined and reconceptualized by considering on this dynamic structure. In this study, the geographic and spatial structure of an urban area, gender differences, socioeconomic structures of households are investigated in detail to reflect which of them have a consistent relationship with commuting pattern in the IMA. Moreover, by focusing on the spatial distribution of working areas and employment, imbalances in land uses are tested by the help of the volume of working travel in local context.

Investigations based on the standard model of urban economics provide the theoretical background on home to work travel pattern studies. The standard model of urban economics states that choice of residential location is based on trade-off between commuting cost and land cost. In his model, Alonso (1964) placed all jobs at the urban core and sought to explain households' residential location choice as the outcome of their trading off accessibility to work (distance) versus housing consumption (space). The cost of land tends to decrease with the increase in Euclidean distance from the center while keeping other factors affecting land value constant. Home to work distance is an indicator of how much travel actually takes place. The commuting time tends to increase with the increase in the home to work distance while keeping all other factors affecting travel time constant. If the distance between home to work is correlated with land and housing cost, individuals who choose greater distances should be able to improve the quality and size of their home, ceteris peribus (Levinson, 1998; Levinson & El-Geneidy, 2009). Connectedly, priority of work over home built on standard model of urban economics (Levine, 1998). Debate has gone over two main approaches. The first approach emphasizes that household residential location choices are systematically determined relative to the households' workplaces. The direction of causation is not clear (Hanson & Pratt, 1988; Halvorson, 1973; Horton & Wittick, 1969). By contrast, in the second approach, the residential location is seen as mobile and depends on the location of predetermined workplace. However, these two approaches have been discussed because of their missing consideration on other issues that residential location preferences also depend on. The actual locations chosen by households can be explained as optimal compromise locations given the work sites, neighborhood qualities, and access to destinations such as schools, shopping and other amenities, and price patterns (King, 1976; Levinson & El-

Geneidy, 2009). Therefore, the behavioral assumption of cost-minimization for just the journey to work in the standard model is inadequate when explaining the relation between job and housing location decision. The sociodemographic and economic changes of recent decades is the another issue that the standard urban economics model is not considered. The standard model is constructed on the one wage earner, who is a man, and focused on traditional family type. However, there is excess in nontraditional families nowadays which is needed to give sufficient attention to varying subgroups. Also, two wage earners families is remarkably increased in last decades which directly affect the residential location decision; the residential location must accommodate two job locations, and, the affordable range of houses and neighborhoods have extended by increasing income. Standard model presume that commuting costs are compensated by lower housing prices. In the model, the work location is fixed and commuters are in the optimal situation which defines the market perfection. Van Ommeren et all (1997) discussed the effect of market imperfections on commuting behavior. In this study, by considering the standard urban economics model, it is investigated whether there is an observable trade-off between commuting cost and land cost. Additionally, the analysis is expanded by focusing on the two wage earner families and discussed how residential location choice is affected by the situation.

Kim et all (2005) emphasize that there is a strong linear relationship between travel time to work and travel cost to work and housing prices. However, King (1976) assumes a trade-off between the goals of low commuting costs and a high quality neighborhood. He explains the tendency of households to locate in other than the cheapest market in terms of the neighborhood quality. In this study, because of the data limitation, neither the relationship between commuting cost and housing prices nor trade-off between commuting cost and neighborhood quality could be investigated.

3. Data and Methodology

Data

The data source comes from a 'Household Research' survey that was conducted by Istanbul Greater Municipality between 2005 and 2006. The survey sample is based on varying densities of housing areas. Housing areas are defined under three basic density levels as: low density (implies less than 250 person/hectare), medium density (implies between 250-500 person/hectare) and high density (implies more than 500 person/hectare). Neighborhoods are

selected randomly for the administration of a survey instrument corresponding to these areas and the sampling size is based on the population of these three segments. Therefore, the survey can be considered to be representative of housing areas with three varying densities. The final survey covered 947 neighborhoods and 3,862 households.

The 'Household Research' survey consists of seven main modules (1) the socio-demographic structure of households such as age and family size (2) the socio-economic structure of households such as income, employment status, car ownership and educational attainment (3) housing characteristics such as room number, floor area, bathroom number (4) the home to work journey such as the place of work and journey to work characteristics of workers (5) the intentions to move into a new housing area (6) the satisfaction with housing environment such as satisfaction with public places, green areas or high accessibility to various facilities, and (7) the observed problems related to housing environments such as green area capacity and car parking.

In the survey, respondents' answers provide information about where people work, how they travel, and how long it takes them to get there. However, the data set has some limitations. It is unable to analyze the volume of commuter travel at different time periods during a typical day because of lacking data corresponding to the analysis. By following the standard model of urban economics, it could be emphasized that if the Euclidian distance between home and work is correlated with land and housing costs, individuals who choose greater Euclidian distances should be able to improve the quality of their home, ceteris paribus. Unfortunately, the data set does not provide an opportunity to test whether this is the case for the IMA or not.

Methodology

The analysis to reflect the home to work journey pattern in the IMA is conducted to the extent of three topics. Consistently, analyses are developed by focusing on varying subjects expecting to have an impact on home to work journey pattern; commuting cost and land cost relation based on Alonso's trade-off model; and, local context in terms of spatial distribution of workers both on working and residential areas to understand the home to work journey pattern in the IMA.

4. Analysis and Findings

The Home to Work Journey Pattern

In this group, the commuting pattern is analyzed by focusing on commuting time and commuting type. The average commuting time in the IMA is 29 minutes. However, this average value changes between two geographic parts of the metropolitan area. For instance, the average commuting time in the European part (28 min.) is shorter than that the Asian part (32 min.). By applying independent-samples t-test, it is tested whether commuting time significantly differs between two geographic parts of the metropolitan area. The test results support the significantly different commuting time between the European part (M=27.12, SD= 21.456) and the Asian Part [M=31.08, SD= 26.383; t(2275)= -3.486, p=.000]. The expected reason for this changing commuting time between two geographical parts would be the ratio distributions of workers who are working at one geographic part and living in the other. In Istanbul case, 16% of workers, who are living in Asian part, cross the Bosphorus in every day to work at the European part.

In addition to understand how commuting time differ between two main geographical parts of the metropolitan area, it is explored whether the commuting time is sensitive to variations in the urban structure. In this study, urban structure is limited with the varying housing density areas (Darroch, 1972). Housing areas are defined under three basic density levels as: low density (implies less than 250 person/hectare), medium density (implies between 250-500 person/hectare) and high density (implies more than 500 person/hectare). Low density housing areas are expected to have higher commuting time than that the high or medium density areas because of their long distance location to the central areas. A one-way analysis of variance is conducted to explore how commuting time changes according to density. There is a significant difference at the $p<.05$ level in commuting times for the three density groups [F (2, 2272) = 6.7, p= .001]. Despite reaching statistical significance, the actual difference in mean scores between the groups is quite small. The effect size, calculated using eta squared, is .005. Post-hoc comparison using the Tukey test indicated that the mean score for medium density housing areas (M=30.36, SD= 24.98) is significantly different from the mean score for high density housing areas (M= 26.47, SD= 20.69). As opposed to expectation, the commuting time in low density housing areas (M= 27.73, SD= 23.34) does not differ significantly from the commuting time in either medium or high density housing

areas. In summary, in the Istanbul metropolitan area commuting time differs not only in two geographic parts of the city but also in varying housing density areas.

Furthermore, it is explored whether the commuting time reflects a remarkable change according to gender. Traditionally, it is accepted that men have had longer commutes than women. Therefore, commuting time is tested to see whether the results in the IMA reflecting the coincidence with the traditional acceptance. An independent-samples t-test is conducted to compare the scores for primary wage earner males and females. Test results reflect that there is no significant difference in commuting times for males (M= 27.78, SD= 22.05) and females [M= 28.35, SD= 23.19; t(2275)= -.284, p= .77]. Similar result is got for the secondary wage earners as well. The results emerge that there is no significant difference in scores for males (M= 28.33, SD= 20.43) and females [M= 27.08, SD= 22.74; t(789)= .813, p= .41].

As a last, the relationship between commuting time and commuting type is explored. Crosstab results show the significant relations between commuting time and commuting type (Pearson Chi-square= 577.109, p= .000). The commuting time remarkably changes according to commuting type. For instance, the bus users commuting time is the longest among the other vehicle users (32.6% of them commuting longer than 41 minutes). While the 50% of train users commute in 16-30 minutes, this rate decreases to 46.6% for minibuses users, to 38.5% for underground users, to 36.5% for drive alone, and 33.3% for ferry users. The shortest commuting time mostly belongs to walking people (74.5% of them commute at less than 15 minutes). Moreover, this analysis is developed by considering the gender difference in commuting time and explored how commuting type differs for men and women. The Chi-square test for independence is applied to determine whether two categorical variables are related. For the primary earners, test result reflect that the proportion of males and the proportion of females is not significantly different which means that commuting type is not differed according to gender (Pearson Chi-square= 8.04, p= .624). However, the controversial result is reflected for the secondary earner. Commuting type significantly differs for males and females (Pearson Chi-square= 36.04, p= .000). This difference between primary and secondary wage earners might result of gender distribution of these two groups (the 94.5% of primary wage earners are men, the 44.2% of secondary wage earners are women).

After all, the analysis on commuting time, commuting type and commuting distance is enhanced by including the some social parameters. The test results show that although the commuting time is not significantly differing according to occupation of the workers [F(9,

2265)= 1.421, p= .173], it significantly changes according to their sectoral distribution (Pearson Chi-square= 42.725, p= .000). While most of the retail sector workers commuting time range lowest through 20 minutes, most of the manufacturing sector workers commuting time range 20 minutes through highest. Although most of the services sectors workers commuting time are longer than that the retail sector workers at the range 30 minutes through highest, it is shorter than that the manufacturing sector workers'. On the other side, commuting type significantly differs both according to occupation (Pearson Chi-square= 302.722, p= .000) and sectoral distribution of workers (Pearson Chi-square= 171.912, p= .000). For unskilled laborers, store and office clerks and craftsmen, walk to work gets the highest percentages (34.1%, 27.7% and 26.9%, respectively). Bus is widely used by personal services (27%); drive alone gets the highest rate at semi-professionals, professionals and administrators (38.9%, 36.5% and 37.5%, respectively). The percentage of walk to work is changed between 23% and 30% among manufacturing, service and retail sectors. Drive alone reaches the highest percentage in service and retail sector, 25.1% and 25.4% respectively. However, manufacturing sector workers generally use alternative commuting types with similar percentage distributions such as drive alone (18%), minibuses (15.9%), buses (19.3%) and company buses (17.9%).

In addition to the occupation and working sector, it is also explored whether the commuting time changes according to income level. It is expected that in high income groups commuting time would be higher than that low income groups because this group generally tends to trade-off between commuting costs and land costs. Test results put that there is not a statistically significant difference in income and commuting time scores [F(4, 1993)= .369, P= .831] in the IMA case.

Analysis is developed for home owners and renters as well. It is expected that renters commuting time is shorter than that the owners since their ability to residential mobility is higher than that the owners. However, analysis results reflect that there is not a statistically significant difference between commuting time of renters (M=28.31, SD= 22.971) and home owners [M=28.29, SD= 23.216; t(2273)= -.025, p= .980]. This might show that the work area is not a primary concern for renters' residential location decisions. Alike the secondary role of work area location on residential location decision in home ownership, it is again in secondary role on rental housing location decision behind the rent value.

The Standard Model of Household Behavior

The basic assumption of the standard model of urban economics about household behavior is that the choice among residential locations determined by a trade-off between commuting cost and land cost. In his model, Alonso (1964) placed all jobs at the urban core and sought to explain households' residential location as the outcome of their trading-off accessibility to work (distance) versus housing consumption (space). By following the standard theory, it is investigated whether a trade-off is observable in residential location decisions in the IMA.

Commuting cost and land cost relation is analyzed by following Alonso's trade-off assumption. The limitation is that the data set does not provide an opportunity to count the commuting cost in a monetary term. Therefore, commuting time is substituted with commuting cost by assuming an increase in commuting time means an increase in commuting costs. So, it is tested whether the relationship between commuting time and housing size (floor area and room number) is linear or not. Due on purpose, first, both the average commuting time and floor area values are classified into five groups and looked at the percentage distributions of floor area groups on commuting time groups. In all five commuting time groups [(1) 10 minutes<, (2) 11-20 minutes, (3) 21-30 minutes, (4) 31-40 minutes, (5) <41 minutes], the highest rate belongs to the houses between 76-125 m^2. There is no remarkable change in floor areas of houses located at neither short distance nor long distance commuting time; the percentage distributions of 76-125 m^2 houses among five commuting time groups are 60.4%, 58.3%, 60.4%, 61.2%, and 60.5%, respectively. Consequently, frequency distribution does not show a systematic increase in housing size according to increasing commuting time.

Further, by following the basic assumption, it is explored whether there is a linear relationship between the increasing commuting time and housing size (floor area). There is a weak, positive correlation between the two variables [r^2= .058, n= 1867, p= .012] which says that there is not much overlap between them. In another word, their shared variance, 0.3 percent, is quite low. Nonetheless, the relationship is analyzed whether something changes if floor is substituted by number of rooms in a dwelling. The test result reflects that there is not a statistically significant relationship between the number of rooms and commuting time [r^2= .032, n= 2275, p= .024]. Subsequently, in Istanbul case, it could be barely said that there is a trade-off between commuting time and housing size. The metropolitan area does not have a monocentric structure as assumed by Alonso's model. The multicenter development of the metropolitan area and the high percentage of workers who both live and work at the same

district may be the two important reasons the city differ from the standard theory. Furthermore, it is obvious that residential location choice also depends on access to destinations such as schools, shopping and other amenities. Therefore, the behavioral assumption of cost minimization for just the journey to work in the standard model is inadequate when explaining the relation between job and housing location. This would be the case in this study and only the behavior of cost minimizing in the standard model is not adequate to explain commuting.

The other important issue is to understand how important the access to the workplace in residential location choice. The data provides the percentage distribution of the mobility reasons in the total (Table 1.). The distribution shows that the access to job areas is less important than that the being owner a home and the affordable housing price. In this case, it could be difficult to say people have taken their present job first and then found a place to live or they have looked for their present job from an established residential location.

Table 1. The percentage distribution of mobility reasons

Characteristics of areas	**Low density housing areas**	**Medium density housing areas**	**High density housing areas**
Being owner a home	**42.5**	**39.5**	**32.3**
Affordable housing price	**18.0**	16.3	15.9
Close to the job area	16.9	**18.1**	**20.4**
Close to the relatives	8.1	10.4	15.5
Being familiar with the district	4.8	5.2	6.9

Beyond evaluating the role of the access to work areas on residential location choice in the total, the commuting time and residential location choice relationship is explored in detail as well (Table 2.). By following the table, it might be said that the access to job apparently be more important in residential location choice in shorter commuting times than that the being owner a home. In this group, residential location might be thoroughly determined according to the households' workplaces. However, this situation changes in longer commuting times. As commuting time increases, the impact of the rate of access to job on residential area location decision is decreasing, on the contrary the rate of the being owner a home is increasing. Therefore, in Istanbul case, being owner a home is more important on residential location choice and people willingness to spend longer commuting time for being owner a home. The other important result derived from the frequency distribution is the environmental quality has a remarkably weak affect on residential location decision.

However, environmental quality is expected to affect on both the residential and work location decision.

Table 2. The percentage distribution of mobility reasons according to varying commuting time

	Being owner a home	**Affordable housing price**	**Close to the job area**	**Close to the relatives**	**Environmental quality**
>10 minutes	32.5	11.5	**32.5**	19.1	3.7
11-20 minutes	28.0	16.7	**33.2**	18.7	3.3
21-30 minutes	**33.0**	20.0	26.9	16.7	2.2
31-40 minutes	**36.2**	24.1	16.4	18.1	4.3
< 41 minutes	**39.1**	15.3	22.6	20.5	1.9

The other analysis is developed to understand how residential location choice is affected by the primary and secondary wage earners employment. The primary wage earners emphasize that the price of the house is the most (33.5%) and the being close to work area is the second most (28%) important factor that affect on residential area location decision. However, these figures replace for the secondary wage earners. While the being close to work area is the most important factor (32.4%), this is followed by the price of the house (28.4%) for the secondary wage earners' residential area location decision. To capture the possible reason of this remarkable difference between the primary and secondary wage earners' residential area location decisions, it is explored the gender distribution of primary and secondary wage earners. Frequency distributions show that there is a striking difference on gender distribution of primary and secondary wage earners. The 94.5% of primary wage earners are men, however, this rate decreases to 55.8% and the percentage of women increases from 5.4% to 44.2% when they are secondary wage earners. Therefore, the shift in residential area location decision according to primary and secondary wage earners might be affected by the gender distribution (Singell & Lillydahl, 1986). Consequently, this result would consistent with the traditional acceptance; women are more likely than man to be locally oriented in the Istanbul case.

The other important issue is to analyze how the trade-off between commuting cost and land cost affected by in case of two earners in a household. In the IMA there is a remarkable difference on one and two wage earners families rate; one wage earner families reflect the 55.6% of the total while two wage earners reflect 25.9% of it. The increased income because of two wage earners in a household is accepted to extend the range of houses and neighborhoods that are affordable which both increases or narrows residential location options considering two job locations. In Istanbul case, test result shows the significant

income difference between one wage earner (M= 989, SD= 828.701) and two wage earner families [M= 1405, SD= 919.23; t(2811)= -11.542, p=.000]. The magnitude of the difference in the mean is moderate (eta squared= .045). However, neither the floor area of houses *(one wage earner families (M= 96.30, SD= 24.481) and two wage earner families [M= 96.35, SD= 27.427; t(2606)= -.050, p= .960])* nor the number of rooms *(one wage earner families (M=3.32, SD= .767) and two wage earner families [M=3.33, DS= .833; t(3146)= -.331, p= .741])* and the lot size of house *(one wage earner families (M= 244.38, SD= 206.866) and two wage earner families [M= 252.68, SD= 207.135; t(1560)= -.743, p= .457])* significantly differ between these two groups. This result emphasizes the importance of the being owner a home relative to the other factors one more time. In the IMA case, the main concern of residents is being owner a home which is weakens the impact of other factors such as the size of a house, the being close to the work area etc. Therefore, the relationship between commuting costs and land costs could not be explained by an expected income increase via increase in working person in a family in Istanbul case. On the other side, there is a significant difference in commuting times of one wage earner families (M= 24.34, SD= 17.492) and two wage earners families [M= 28.37, SD= 17.926; t(3027)= -5.892, p= .01]; however, the magnitude of the difference between two groups is small (eta squared= .01). Longer commuting times of two wage earners families might show their acceptance of commuting cost in relation with their higher income than those one wage earner families.

Theory emphasizes that the higher the income, the less important the journey to work travel cost become. So, commuting time differences according to varying income groups are explored. At first, by following the data, income is classified into five groups [(1) 1000 TL<, (2) 1001-2000 TL, (3) 2001-3000 TL, (4) 3001-4000 TL, (5) <4001 TL], then, it is looked at the percentage distributions of these income groups on the five commuting time groups, which are reflected in formerly. Families whose income is lower than 1000 TL have the highest rate (between 60.3% and 62.6%) in any commuting time groups. The remarkable difference is observed in two longest commuting time groups (31-40 minutes and <41 minutes). The rate of the families whose income changes between 2001-3000 TL is above 21% both in these two groups. Although it could not be generalized by considering only on these figures, it might be said that this high income group which reflect almost the 20% of the total tend to accept the commuting cost as a result of longer commuting time. Further, it is tested whether the commuting time significantly differs in varying income groups. Test results reflect that (Pearson Chi-square=10.508, p=.839) the proportions of five income

groups are not significantly different from each other and this means that according to the income levels the commuting time is not changed.

The Local Context

As emphasized at the introduction part, almost 70% of the employment is clustered in the European part and 30% of it in the Asian part. 16% of the workers who are residing in the Asian side travel from the Asian side to the European side in every day to be able to reach their job areas. Because these figures are expected to reflect clear imbalances of the distribution of working areas and employment across the metropolitan area, it is explored in detail whether the commuting time differs in macro scale (two main geographic parts-namely, European and Asian parts) and micro scale (districts within the boundary of the metropolitan area). At the end of the analyses, it is expect to make clear how the volume of travel is affected by the imbalances. Independent t-test results put that there is a significant difference in commuting time for workers who is living and working at the same geographic part (M=25.67, SD= 20.306) and workers who is living and working at the different geographic parts [M= 61.78, SD= 29.617; t(2208)= -14.492, p= .000]. The magnitude of the differences in the means are moderate (eta squared= 0.08). Further, investigation is developed by focusing on each geographic part separately. In the Asian part, independent t-test results put that there is a significant difference in commuting time for workers who is living and working at the Asian part (M=24.20, SD= 19.714) and workers who is living in Asian part but working at the European part [M= 63.43, SD= 29.017; t(661)= -13.285, p= .000]. The magnitude of the differences in the means are extremely large (eta squared= 0.22). In the European part, there is a significant difference in commuting time for workers who is living and working at the European part (M=26.22, SD= 20.500) and workers who is living in European part and working at the Asian part [M= 57.56, SD= 31.067; t(1547)= -6.422, p= .000]. The magnitude of the differences in the means are moderate (eta squared= 0.02), however, the strength of the difference is weaker than the Asian part. The eta squared values reflect an obvious difference between the volumes of travel flow from the Asian side to the European side and from the European side to the Asian side. Subsequently, for workers who are crossing the Bosphours from the Asian side to the European side have the highest commuting time than that the remaining.

In addition to the investigation on geographical parts-macro scale, the analysis is expanded through the micro scale-districts. The 31.5% of workers both live in and work at

the same district in the IMA. However, this rate reflects differences among varying sector workers. For instance, the rate of workers both live in and work at the same district increases to 58% for manufacturing sector, 45% for service sector and 58% for retail sector. Therefore, the imbalance at the distribution of residential areas and manufacturing and retail areas is weaker than that the imbalance at the distribution of residential areas and business districts. In such a situation, two tests are developed (1) whether the work location is inside the limits of the districts where people live in, (2) whether the commuting time significantly differs for workers whose living and working areas are at the same district and workers whose working and living areas are at the different districts.

The first test is developed to understand the micro pattern of commuter travel. Test results reflect that (Pearson Chi-square= 363.525, p= .000) the proportion of workers whose living and working areas are at the same district is significantly different from the proportion of workers whose working and living areas are at the different districts. Consequently, the volume of travel in flows is mainly emerged within the boundaries of districts where the workers both residing and working in the IMA. In Istanbul, workers mainly tend to live and work in the same district. This might be the because of remarkable commuting time difference between these two groups. Independent t-test results put that there is a significant difference in commuting time for workers whose living and working areas are the same (M=16.84, SD= 12.127) and workers whose living areas are different from their working areas [M= 41.46, SD= 25.418; t(2190)= -28.027, p= .000]. The magnitude of the differences in the means are very remarkable (eta squared= 0.264).

After exploring the commuting time difference for total sample, it is explored for varying sector workers as well. Expanded analysis show that if the workers of manufacturing, service and retail sectors live and work at the same district, their commuting time is shorter than that the others whose living and working districts are apart from each other *[(For manufacturing sector: workers whose living area is the same with their working area (M=17.77, SD= 12.764) and workers whose living area is different from their working area [M= 41.09, SD= 25.165; t(894)= -16.905, p= .000]); (For service sector: workers whose living area is the same with their working area (M=17.49, SD= 12.992) and workers whose living area is different from their working area [M= 44.28, SD= 26.575; t(536)= -14.113, p= .000]); (For retail sector: workers whose living area is the same with their working area (M=15.50, SD= 10.800) and workers whose living area is different from their working area [M= 39.26, SD= 24.329; t(749)= -15.793, p= .000])*]. Moreover, the magnitude of the

differences in the means are striking for each sector (eta squared= 0.242; 0.299; 0.250 for manufacturing, service and retail sector respectively).

5. Concluding Remarks

This paper investigates home to work travel pattern in the Istanbul Metropolitan Area. Investigation explores commuting pattern in three steps. In the first step, the reasons for changing commuting time are explored. In the second step, the home to work travel pattern is explored whether it reflects consistency with the standard urban economic theory. In the third step, the home to work pattern is investigated in local context in terms of spatial distribution of workers both on working and residential areas.

The result of the analyses show that commuting time significantly changes according to some subjects. For instance, varying housing densities, gender, occupation and commuting type has an impact on commuting time. However, as opposed to expectation and previous studies the tenure type and the income do not change the commuting time significantly.

Commuting cost and land cost relation is analyzed by following Alonso's trade-off assumption. The behavioral assumption of cost minimization for the journey to work in the standard model is inadequate when explaining the relation between job and housing location in the IMA. In Istanbul case, being owner a home is more important on residential location choice and people would like to spend longer commuting time for being owner a home.

Analysis results reflect an obvious difference between the volumes of travel flow from the Asian side to the European side and from the European side to the Asian side. Workers who are crossing the Bosphours from the Asian side to the European side have the highest commuting time than that the remaining. The volume of travel in flows is mainly emerged within the boundaries of districts where the workers both residing and working in the IMA.

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